

CLAIMS

- 1 1. A method for detecting a quantitative measure of a physiologic state of a human
2 myocardium or coronary artery, the method comprising:
3 a) attaching at least one electrode pair to the myocardium;
4 b) recording baseline measurements of the mean myocardial electrical impedance
5 and computing the variance of the myocardial electrical impedance between each
6 electrode pair;
7 c) computing a baseline value of mean myocardial electrical impedance from the
8 baseline measurements;
9 d) periodically measuring mean myocardial electrical impedance values between
10 each electrode pair over an interval of time and storing data representing the
11 impedance values as a function of time; and
12 e) after the mean myocardial electrical impedance changes from the computed
13 baseline value by at least the measured variance, diagnosing the extent of change
14 in the myocardial physiologic state as a continuous, smooth, function of the extent
15 of change, or rate of change, of the periodically measured myocardial electrical
16 impedance from the baseline value.
- 1 2. A method in accordance with claim 1 wherein:
2 a) the physiologic state is the extent of ischemia of a portion of the myocardium; and
3 b) after the mean myocardial electrical impedance between the electrode pairs rises
4 above a value equal to the arithmetic sum of the baseline myocardial electrical
5 impedance and the variance, myocardial ischemia severity is diagnosed as a
6 continuous, smooth, increasing function of the extent of the rise of the mean
7 myocardial electrical impedance above the baseline value.

1 3. A method in accordance with claim 1 wherein:

- 2 a) the physiologic state is the extent of stenosis pre-existing in a coronary artery;
3 b) each electrode pair is attached to the myocardium in the region of the myocardium
4 perfused by the coronary artery;
5 c) the coronary artery is occluded proximally after recording the baseline
6 measurements; and
7 d) after the mean myocardial electrical impedance between the electrode pair rises
8 above a value equal to the arithmetic sum of the baseline myocardial electrical
9 impedance and the variance, the extent of stenosis pre-existing in the coronary
10 artery is diagnosed as a continuous, smooth, decreasing function of the extent of
11 rise of the mean myocardial electrical impedance above the baseline value.

1 4. A method in accordance with Claim 3 wherein the continuous, smooth, decreasing
2 function is substantially:

3
$$\%stenosis = -2.89 \times \%MEI + 410.044,$$

4 wherein

5 %stenosis is the percent pre-existing blockage in the coronary artery and
6 %MEI is the increase of the mean myocardial electrical impedance above the
7 baseline value expressed as a percent.

1 5. A method in accordance with claim 1 wherein:

- 2 a) the physiologic state is the extent of reperfusion of a portion of the myocardium;
3 and
4 b) after the mean myocardial electrical impedance between the electrode pairs
5 declines below a value equal to the arithmetic difference of the baseline
6 myocardial electrical impedance and the variance, the myocardial reperfusion
7 level is diagnosed as a continuous, smooth increasing function of the extent of the
8 decline of the mean myocardial electrical impedance below the baseline value.

1 6. A method in accordance with Claim 5 whereby the efficacy and level of success of
2 coronary artery bypass surgery is diagnosed as the extent of reperfusion.

1 7. A method in accordance with claim 1 wherein:

2 a) the physiologic state is the extent of myocardial tissue rejection following heart
3 transplantation; and

4 b) after the mean myocardial electrical impedance between the electrode pair rises
5 above a value equal to the arithmetic sum of the baseline myocardial electrical
6 impedance and the variance, the myocardial tissue rejection severity is stratified as
7 a continuous, smooth, increasing function of the rise of the myocardial electrical
8 impedance above the baseline value.

1 8. A method in accordance with claim 1 wherein:

2 a) the physiologic state is the effectiveness of cardioplegia of the myocardium during
3 on-pump coronary artery bypass graft surgery;

4 b) the method further comprises, after recording the baseline measurements, placing
5 the myocardium on bypass and applying a selected type of cardioplegia;

6 c) after the mean myocardial electrical impedance between the electrode pairs rises
7 above a value equal to the arithmetic sum of the baseline myocardial electrical
8 impedance and the variance, the effectiveness of the cardioplegia is diagnosed as a
9 continuous, smooth, decreasing function of the rise of the myocardial electrical
10 impedance rises above the baseline value.

1 9. A method in accordance with claim 1 wherein:

2 a) the physiologic state is the effectiveness of ischemia preconditioning of the
3 myocardium during coronary artery bypass graft surgery;

4 b) the baseline measurements are recorded immediately prior to placing the heart on
5 bypass;

6 c) the method further comprises, after preconditioning and the beginning of the
7 ischemic period of surgery, calculating the rate of rise (ohms/minute) of the
8 myocardial electrical impedance; and

- 9 d) the diagnosing step more particularly comprises diagnosing the effectiveness of
10 the ischemia preconditioning as a continuous, smooth, decreasing function of the
11 extent of the rate of rise of the myocardial electrical impedance.